Docket No. VERTE.032CPCCC1D
Serial No. 10/726,774
§ 1.132 Affidavit of Cole Franklin

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:		Mario E. Bran
Serial No.	:	**10/726,774**
Filed	:	December 3, 2003
Art Unit	:	1746
Examiner	:	Zeinab El Arini
Attorney Docket:		VERTE.032CPCCC1D
Title: BY THE	:	METHOD OF CLEANING A SIDE OF A THIN FLAT SUBSTRATE APPLYING SONIC ENERGY TO THE OPPOSITE SIDE OF SUBSTRATE

AFFIDAVIT OF COLE FRANKLIN UNDER 37 C.F.R. § 1.132

1. I, Cole S. Franklin, am an individual residing at 314 E. Ave. Ramona, San Clemente, California, and am a citizen of the United States of America.

2. In 1991, I received a Bachelor of Science Degree in Applied Physics from the University of California Irvine with an emphasis in electrical engineering and plasma physics

3. For over 14 years I have been a senior technologist, research & development manager, and business consultant for the semiconductor manufacturing equipment industry, with a focus in the technical field of semiconductor cleaning and drying equipment. My experience includes research, training, and/or product development in the following technical fields within the semiconductor manufacturing industry: cavitation control using a specialty gas mixtures; controlling cavitation using apparatus that balance pressure events; quartz lens designs for megasonic directivity control; mixed acoustic signal methods for single wafer cleaning; dual-side cleaning of top and bottom surfaces of wafers with acidic and basic chemicals; single wafer horn megasonics using advanced wave technology for integration on to polishing tools; high and low frequency buffered cavitation electric signal design; cavitation activity and event detection systems; audible cavitation sensing; hydrodynamic single wafer cleaners (no megasonic, no spray); batch megasonic cleaning improvement techniques; controlling cavitation using special liquid mixtures by changing physical properties; liquid mix or additive to control cavitation damage; and uniformity improvement methods for both curved and array transducer.

4. I am a named inventor in United States Patent Application Publication 2002/0185155, entitled *Method of Applying Liquid to a Megasonic Apparatus for Improved Cleaning Control*; United States Patent Application Publication 2004/0134514, entitled *Megasonic Cleaning System with Buffered Cavitation Method*; and United States Patent Application Publication 2005/0161059, entitled *Megasonic Cleaning Using Supersaturated Cleaning Solution.*

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5. I am an author or co-author of the following publications: (1) C. Franklin, J.S. Papanu, S. Shrauti, H. Chen, A. Ko, B. J. Brown, Applied Materials, "Advanced Mask Cleaning Techniques for sub 100nm Technology Nodes" BACUS 2005; (2) C. Franklin, R. Gouk, S. Verhaverbeke, Applied Materials, "Advanced Cleaning for sub 100nm Device Structures" SPWCC 2005; (3) J. Tang, B.J. Brown, A. Ko, R. Endo, S. Verhaverbeke, C. Franklin, D. Yost, R. Chen, Applied Materials, "Solvent Based Single Pass Cu/Low k Cleaning Process Development and Integration into Dual Damascene Process Flow" SPWCC 2005; (4) J. Tang, B.J. Brown, A. Ko, R. Endo, C. Franklin, R. Chen, Applied Materials, "Low Volume Dispense Single Pass Cu/Low k Cleaning Process Development and Integration into Dual Damascene Process Flow" Wafer Cleaning and Surface Preparation Workshop 2005; (5) C. Franklin, Y. Wu, H. Lee, J. Lauerhaas, B. Fraser "Megasonic Cleaning of Sensitive Structures" Electrochem Soc., (2003); (6) C. Franklin, Y. Wu, H. Lee, J. Lauerhaas, B. Fraser "Controlled Cavitation:" Wafer Cleaning and Surface Preparation Workshop, May 2003; (7) J. Lauerhaas, P. Mertens, W. Fyen, K. Kenis, M. Meuris, T. Nicolosi, M. Bran, B. Fraser, C. Franklin, Y. Wu, M. Heyns, ISSM Conference 2000, "Single wafer cleaning and drying: particle removal via a non-contact, non-damaging megasonic clean followed by a high performance "Rotagoni" Dry"; (7) C. Franklin, Y. Wu and T. Nicolosi, CAMP CMP Conference 2000, "Using Acoustic Parameters to Optimize Performance of Single Wafer Non-Contact Post CMP Cleaning"; (8) Y. Wu., C. Franklin, M. Bran and B. Fraser, Electrochemical Society Proceedings, 99-36 (1999) 361, "Acoustic property characterization of a single wafer megasonic cleaner"; (9) Y. Wu, C. Franklin and B. Fraser, Arizona AVS Meeting, May 1999, "Post-CMP megasonic cleaning: characterization and impact of sound distribution"; (10) C. Franklin, Y. Wu, M. Olesen, M. Bran and B. Fraser, Materials Research Society Meeting, Spring 1999, "Single wafer megasonic post-CMP cleaning"; (11) C. Franklin, Y. Wu, M. Olesen, M. Bran and B. Fraser, Semiconductor Pure Water and Chemicals Conference, 18 (1999) 439, "Post-CMP cleaning using a single wafer megasonic cleaner"; and (12) C. Franklin, M. Bran, M. Olesen "Non–contact Cleaning After Chemical Mechanical Planarization," VMIC/CMP–MIC Proceedings February 1997.

6. From 2005 to the present, I have been employed by Akrion, Inc., as a senior technologist where my duties include researching and developing advanced semiconductor cleaning technologies, including the development of cleaning processes for single-wafer megasonic cleaners.

7. From June 2004 to early in 2005, I was employed by Applied Materials Inc. of Sunnyvale California as a senior process engineer in an R&D group focusing on developing advanced semiconductor cleaning technologies such as dry/wet spray jet, megasonic, aero/hydrodynamic, vacuum cavitation, and advanced dry techniques such as cryogenic –spray, UV anneal and dry strip.

8. From 1994 to 2004, I worked for Verteq, Inc. of Santa Ana, California as a senior process development engineer, R&D lab manager, a process engineering manager, a process engineer, and an R&D project engineer. My duties included the research, development, and/or manufacture of wet processing systems for the semiconductor industry for FEOL and BEOL using megasonic cleaning, rinsing, and drying equipment.

10. During my employment at Verteq, Inc., I worked with Mario Bran on projects relating to the single wafer megasonic cleaning system and methods disclosed in United States Patent 6,039,059, which is the parent of the present application, U.S. Serial No. 10/726,774.

11. I have reviewed and am familiar with the methods disclosed and claimed in the present patent application, U.S. Serial No. 10/726,774. As I understand it, in one embodiment the claimed invention is a method of processing a thin, flat substrate having two generally planar opposite sides, comprising: supporting the substrate in a substantially horizontal orientation; flowing liquid onto both planar sides of the substrate; transmitting sonic energy to the liquid on one planar side of the substrate so that the sonic energy passes through substrate and to the opposite planar side of the substrate, thereby loosening particles on both sides of the substrate while maintaining said substantially horizontal orientation. In another embodiment, the claimed invention is a method of cleaning a thin articles having two generally planar opposite sides, said method comprising: applying cleaning fluid to one of said sides while supporting said article in a substantially horizontal orientation; positioning a transmitter adjacent to the other one of said planar sides of the substrate; and applying energy to the other one of said sides via the transmitter with sufficient power to produce vibration on said one side in an area of said cleaning fluid to loosen particles on said one side, while maintaining said substantially horizontal orientation.

12. I have reviewed and understand the teachings set forth in the United States Patent 5,017,236 to Moxness et al. ("Moxness"), which discloses a sonic processing system. In the Moxness system, a transducer assembly (comprising a ceramic transducer and transmitter) is positioned at one end of a fluid filled process chamber in a horizontal orientation and is aligned adjacent to the edge of a substrate. The Moxness system supports the substrate in the process chamber in a horizontal orientation so that its planar surfaces are facing up and down respectively. The interior dimensions of the process chamber of the Moxness system are designed to closely conform to the planar surfaces of the substrate. At the end of the process chamber that opposes the transducer assembly, a sonic absorbing and dissipating antechamber is provided adjacent the edge of the substrate and in horizontal alignment with the transducer assembly.

13. During the operation of wafer cleaning process on the Moxness system, the transmitter assembly of the Moxness system generate sonic energy and transmits this sonic energy through the process chamber in a horizontal direction. This sonic energy travels across the top and bottom planar surfaces of the wafer in a horizontal direction, thereby assisting in particle removal from the planar surfaces of the wafer. After the intensified sonic energy passes across the planar surfaces of the substrate in a horizontal direction, undesired reflection of the sonic energy back into the process chamber is prohibited by the dissipating antechamber that is aligned along the sonic energy path. At no time is does the sonic energy of the Moxness system travel from one planar surface of the substrate/wafer, through the substrate/wafer and to the opposite planar surface of the substrate/wafer, as is required by the methods of the present invention.

14. For the reasons set forth in paragraph 11, the Moxness system does not teach the steps od "transmitting sonic energy to the liquid on one planar side of the substrate so that the sonic

energy passes through substrate and to the opposite planar side of the substrate, thereby loosening particles on both sides of the substrate while maintaining said substantially horizontal orientation." Moreover, the Moxness system does not "apply sonic energy to one planar side of a substrate via a transmitter with sufficient power to produce vibration on the other/opposite planar side of the substrate. Is my further opinion that to construe the teachings of Moxness to the contrary is technologically flawed.

15. I have also reviewed both the Office Action of March 15, 2006 and April 18, 2006 and the Response of April 4, 2006 relating to the present application. I note the position taken in the Office Action that it would have been obvious for one skilled in the art to rearrange the position of the transmitter of the Moxness system with respect to the substrate as a matter of design choice to achieve the claimed inventions. This position, however, is technologically incorrect and one skilled in the art would not modify the Moxness system as suggested in the April 18, 2006 Office Action to achieve the claimed inventions for the reasons set forth in paragraph 14 below.

16. Those skilled in this art understand that, during sonic cleaning applications, it is absolutely critical that the sonic energy be applied to the entirety of the substrate to achieve cleaning of the entire substrate. The size and shape of the transducer assembly of the Moxness system is specifically designed for orientation adjacent to the edge of a substrate so that it can transmit the sonic energy across the planar surfaces of the substrate. The orientation and positioning of the transducer assembly of the Moxness system is necessary to achieve full sonic coverage of the substrate. Rearranging the position of the transmitter of the Moxness system as suggested in the Office Actions would negatively affect the functioning of the Moxness system because only a portion of the substrate would be subjected to the sonic energy, resulting in unacceptable cleaning of the unexposed areas of the substrate and non-uniformity in further processing.

17. Further, at the time of the invention, it was surprising and unexpected that one could process the opposite surface (or both the near and opposite surfaces simultaneously) of a substrate by applying acoustic energy to one planar surface of the substrate so that the sonic energy passes through the substrate to the opposite planar side of the substrate, thereby loosening particles on both sides of the substrate.

18. Therefore, in view of the forgoing, at the time of the invention, it would not have been obvious to modify the Moxness system as suggested in the Office Action to achieve a method of processing a thin, flat substrate having two generally planar opposite sides, comprising: supporting the substrate in a substantially horizontal orientation; flowing liquid onto both planar sides of the substrate; transmitting sonic energy to the liquid on one planar side of the substrate so that the sonic energy passes through substrate and to the opposite planar side of the substrate, thereby loosening particles on both sides of the substrate while maintaining said substantially horizontal orientation.

19. It also would not have been obvious at the time of the invention to modify the Moxness system as suggested in the Office Action to achieve a method of cleaning a thin articles having two generally planar opposite sides comprising: applying cleaning fluid to one of said sides

while supporting said article in a substantially horizontal orientation; positioning a transmitter adjacent to the other one of said planar sides of the substrate; and applying energy to the other one of said sides via the transmitter with sufficient power to produce vibration on said one side in an area of said cleaning fluid to loosen particles on said one side, while maintaining said substantially horizontal orientation.

20. I, Cole Franklin, do hereby swear, affirm, and attest that all statements made in the aforementioned paragraphs are true and correct and that all statements made on information and belief are believed to be true, and further that these statements are made with the knowledge that willful false statements and the like are so made under the penalties of perjury, and that any false statements may jeopardize the validity of the present application or any patent issued thereon.

Date: June 13 2006

Cole Franklin